b. **<u>Domestic Allocation Consistency</u>**.

US footnote 297 of the domestic table of allocations reads as follows:

> "The bands 47.2-49.2 GHz and 74.0-75.5 GHz are also available for feeder links for the broadcasting-satellite service." *47 CFR Section 2.106, Footnote US 297.*

SSI proposes the following revision to the language of Footnote US 297:

> "Use of the bands 47.2-47.5 GHz (Earth-to-stratosphere) and 47.9-48.2 GHz (Stratosphere-to-earth) by the fixed service and by the mobile service is limited to global stratospheric telecommunications service. Stations in the fixed-satellite service may be operated subject to not causing harmful interference to the global stratospheric telecommunications service. The bands 47.5-47.9 GHz, 48.2-49.2 GHz, and 74.0-75.5 GHz are also available for feeder links for the broadcasting-satellite service." *Proposed Revised 47 CFR Section 2.106, Footnote US 297*

Or, in its redlined form, as follows:

> "<u>Use of the bands 47.2-47.5 GHz (Earth-to-stratosphere) and 47.9-48.2 GHz (Stratosphere-to-earth) by the fixed service and by the mobile service is limited to global stratospheric telecommunications service. Stations in the fixed-satellite service may be operated subject to not causing harmful interference to the global stratospheric telecommunications service</u>. The bands 47.~~2~~<u>5</u>-~~49.2~~ <u>47.9</u> GHz, <u>48.2-49.2 GHz</u>, and 74.0-75.5 GHz are also available for feeder links for the broadcasting-satellite service." Proposed Revised 47 CFR Section 2.106, *Footnote US 297*

As described above for the international allocation table, consequential new definitions of *Global Stratospheric Telecommunications Service* and of *Stratospheric Stations* may also be added to the Commission's Rules.

4

US OFFICE PRODUCTS

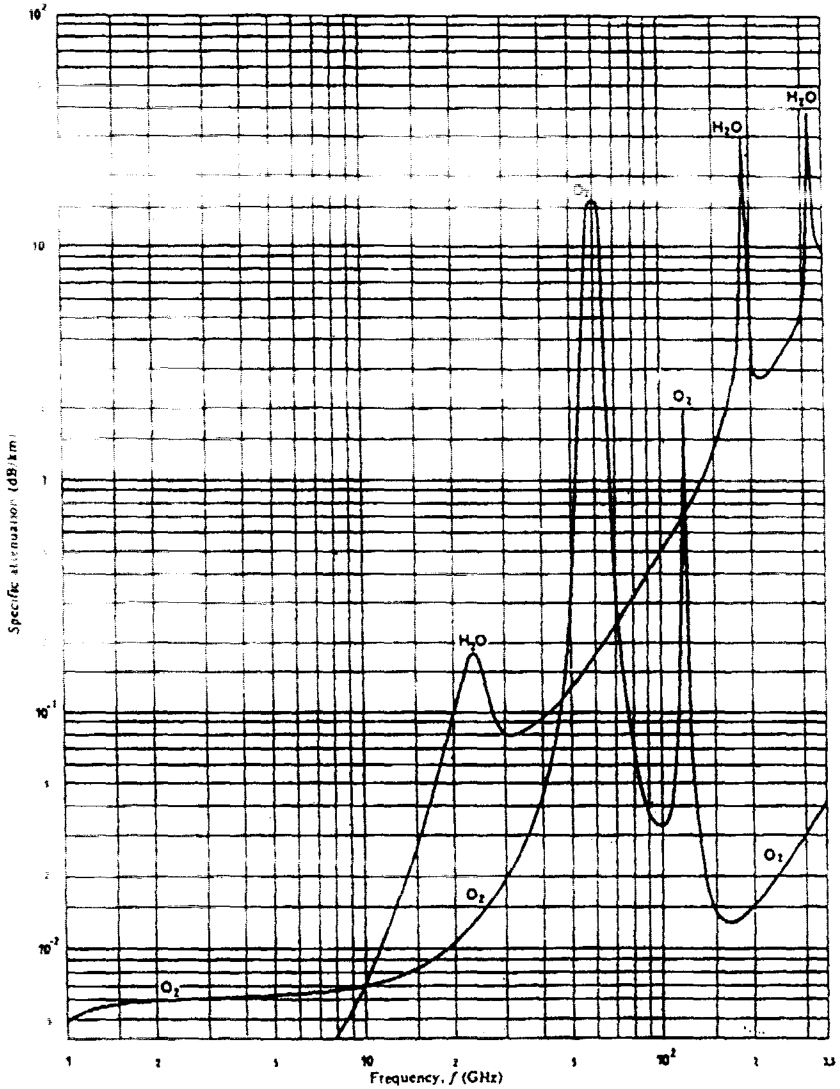
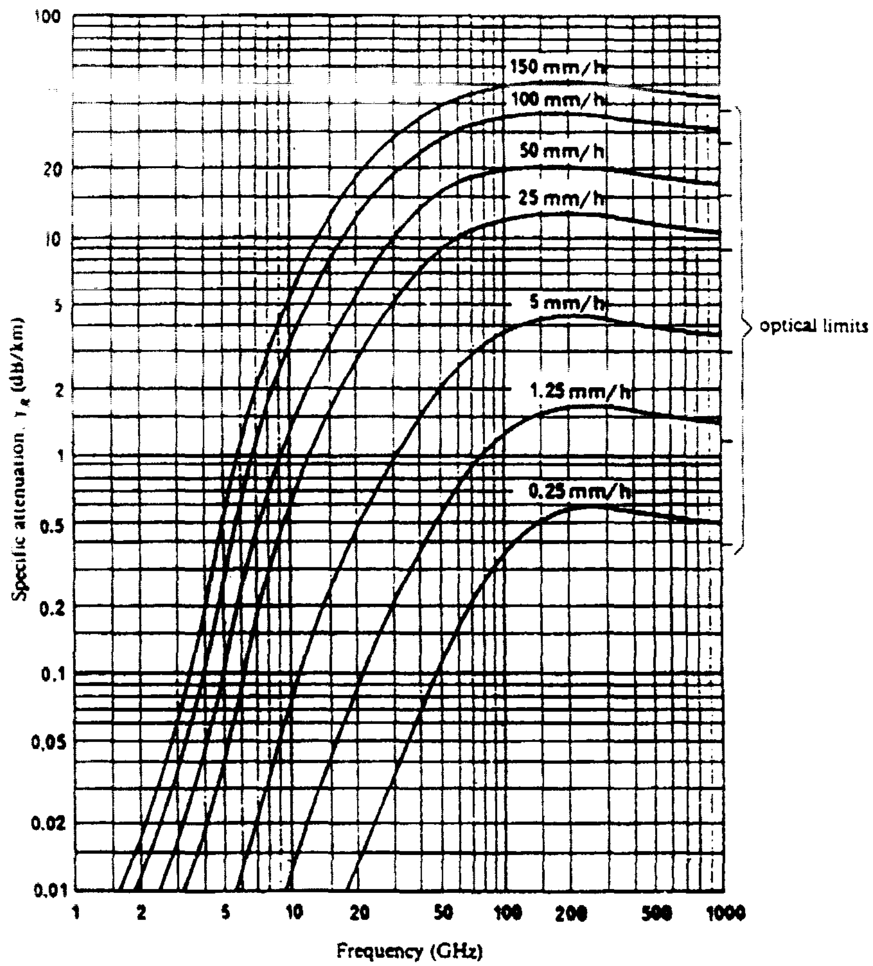


FIGURE 3 – *Specific attenuation due to atmospheric gases*

Atmospheric Rain Attenuation



ORIGINAL

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In re the Matter of Application of Sky Station International, Inc. for Authority to Construct, Deploy and Operate a Global Stratospheric Telecommunications System	)	File No.

APPLICATION OF SKY STATION INTERNATIONAL, INC.

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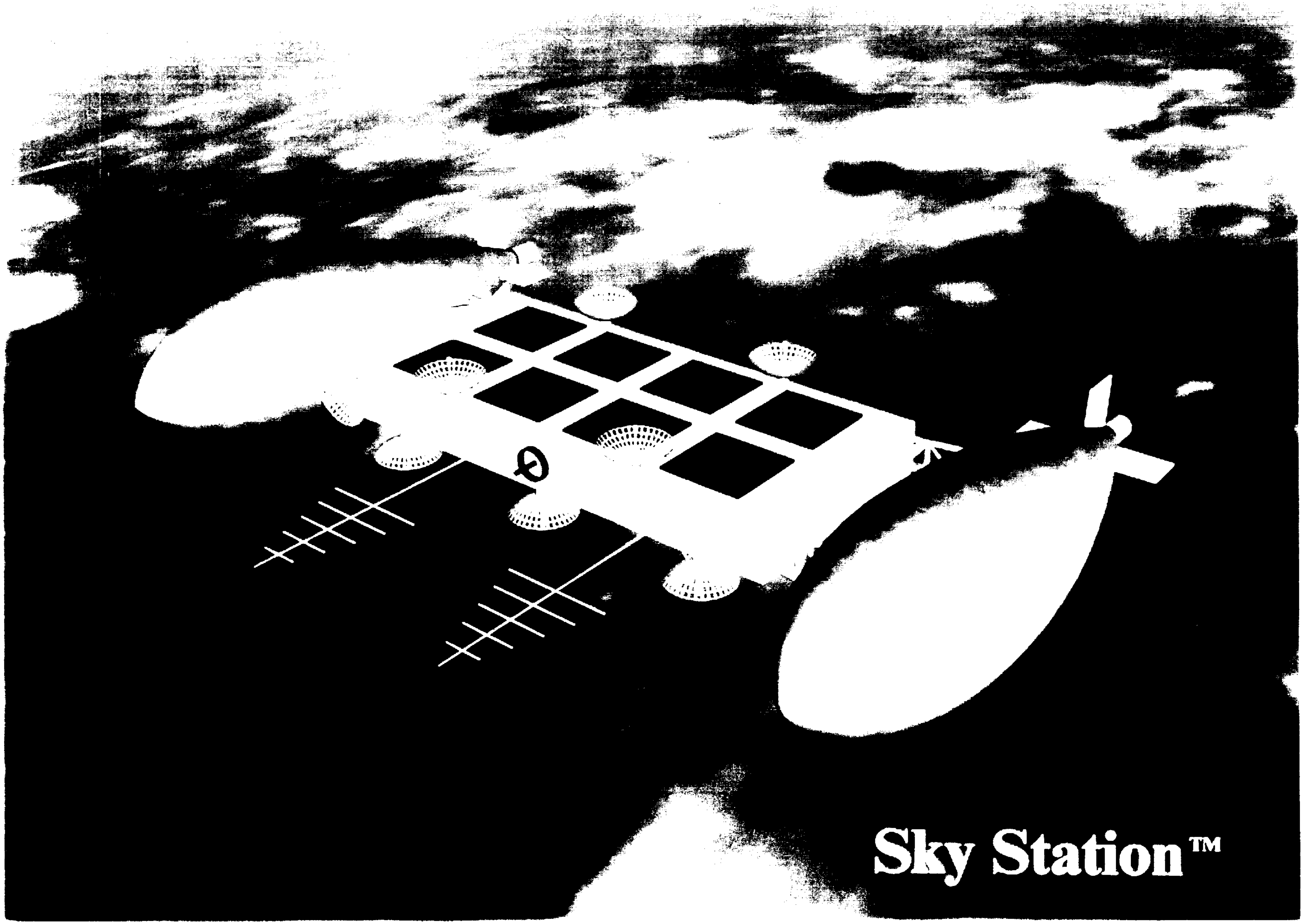
Date: March 20, 1996


Sky Station™

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SUMMARY

Sky Station™ GSTS System

Sky Station International, Inc. ("SSI") hereby requests authorization to construct, deploy and operate Sky Station™ -- a Global Stratospheric Telecommunications System ("GSTS") in the 47.2-47.5 GHz (Earth-to-Stratosphere) and 47.9-48.2 GHz (Stratosphere-to-Earth) frequency bands. Sky Station™ will serve the public interest by providing virtually universal coverage, expanding educational opportunities, enhancing competition, preserving life and property, stimulating the economy, and perpetuating U.S. technological leadership.

As explained below, the Sky Station™ application will satisfy the regulatory principles proposed in the accompanying *Request and Petition* and SSI retains the right to amend the application to comply with the any rules the FCC may adopt for GSTS.

1. **Technical Qualifications.** SSI proposes to operate Sky Station™ using a state-of-the-art global network consisting of 250 geostationary stratospheric platforms equipped with communications payloads. Each solar power stratospheric platform will remain geostationary as a result of the propulsion generated by SSI's recently developed Corona Ion Engine™. The proposed Sky Station™ system would serve over 80% of the world's population. This application explains the technical feasibility of the Sky Station™ system and includes certifications of the engineering proposals.

2. **Financial Qualifications.** SSI will be able to construct, deploy and operate Sky Station™. Its financial and industrial backers currently include General Alexander M. Haig, Jr. and his firm Worldwide Associates, Inc., Chicago industrialist William Wood Prince, and Team Technologies, Inc., all of whom have or have access to

substantial resources and have extensive experience in building and financing new companies here and abroad. SSI also has obtained a letter from the World Bank supporting the development of Sky Station™ and its GSTS proposal. SSI intends to amend its application to demonstrate its financial qualifications prior to the close of the first GSTS application filing window.

3. **Implementation Milestones.** Assuming it is licensed by 1998, Sky Station™ will provide commercial service to a substantial part of the world population by 2002. Over 80% of the world population will be served by 2004. The application explains the proposed Sky Station™ rollout schedule.

4. **Licensing Requirements.** Sky Station™ will be able to operate using a pro rata portion of the proposed GSTS spectrum. The application explains how this is possible and demonstrates SSI's legal qualifications to hold a Commission license.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In re the Matter of Application of Sky Station International, Inc. for Authority to Construct, Deploy and Operate a Global Stratospheric Telecommunications System	)	File No.

APPLICATION OF SKY STATION INTERNATIONAL, INC.

Sky Station International, Inc. ("SSI") hereby requests FCC authorization to construct, deploy and operate Sky Station™ -- a Global Stratospheric Telecommunications Service ("GSTS") in the 47 GHz band.[1/] As explained below, SSI has demonstrated the technical feasibility of Sky Station™, why it would serve the public interest,[2/] and how it will comply with the proposed GSTS regulatory requirements.[3/] For these reasons, the Commission should take the necessary actions to grant this application as soon as possible.

[1/] SSI has concurrently filed with this application a *Request to Establish New GSTS Service, Additional Comments and Petition for Rulemaking* (the *"Request and Petition"*) seeking the establishment of rules for GSTS. SSI believes that its regulatory proposal can accommodate all qualified GSTS applicants. However, SSI also is requesting a pioneer preference in the event that mutually-exclusive applications are filed. The pioneer preference showings are contained in this application and the accompanying *Request and Petition.*

[2/] The public interest benefits of Sky Station™ are explained in the accompanying *Request and Petition* and are incorporated here by reference.

[3/] SSI reserves the right to amend this application to comply with the future rules the FCC adopts for GSTS.

I. DESCRIPTION OF GLOBAL SKY STATION™ TECHNICAL FEASIBILITY AND PROPOSED OPERATION

The Sky Station™ GSTS system consists of a network of 250 Sky Stations™, several thousand ground control and switching centers, and many millions of small, inexpensive portable and mobile Stratus™ Communicators. The entire Sky Station™ system will operate autonomously, but will also fully interconnect with the Public Switched Telephone System (PSTN).

A. Sky Station™ System Geometry

The Sky Station™ system is designed to provide greater capabilities than any existing telecommunications service that is as mobile as GSTS at a price that is lower than any service that provides more mobility. Terrestrial wireless communications systems provide low angles of elevation coverage in urban areas and reduced coverage of outlying areas. Satellite-cellular systems provide higher angles of elevation coverage to both urban and rural areas, but at the expense of reduced capacity to any one area and high cost to all areas. GSTS generally, and the Sky Station™ system in particular, will provide even higher elevation angle service to metropolitan areas and low elevation angle service elsewhere, both at very low cost and with large capacity. The key to understanding the Sky Station™ system's capabilities begins with its geometry.

Each of SSI's 250 Sky Stations™ will be located 30 kilometers (18 miles) above the list of latitude/longitude coordinates provided in Attachment 1. From this altitude, each Sky Station™ communications payload will define coverage areas on the surface of the earth as detailed in Attachment 2. Directly below each Sky Station™ the coverage area will consist of cells with a one mile radius (3.14 square miles). As one moves away from the zenith, the cell sizes expand.

At a distance of 50 kilometers from the zenith location (31 miles along the surface of the earth), each Sky Station™ will be at a position in the sky 30 degrees above the horizon. At this radial distance, which includes 3,019 square miles, the cell radius will now be 4.05 miles with a corresponding coverage area of 51.5 square miles. As one extends further from the zenith point to the horizon, the elevation angle for communication continues to decrease and hence the cell size continues to increase.

The Sky Station™ geometry is well attuned to its service mission. Where population densities are high and transmission path obstacles are ubiquitous -- metropolitan areas -- the Sky Station™ GSTS system offers both small cell sizes with resulting increased capacity and high elevation angles. Where population densities are low and buildings less frequent -- rural areas -- the Sky Station™ system offers large cell sizes with less capacity and lower elevation angles. These fundamental geometric considerations ultimately explain the tremendous cost effectiveness of the Sky Station™ system.

B. <u>Technical Description of Sky Stations™</u>

Each Sky Station™ is a large-scale (up to 650 feet long) environmentally compatible (non-polluting in terms of release of chemicals, debris or other harmful emissions), durable, reusable, lighter-than-air platform. Sky Stations™ use Corona Ion Engines™ to hold the platform stationary at a 30 km altitude and thereby enable it to provide stationary, stratospheric telecommunications services over a wide area. There are many alternative engineering designs for large-scale Sky Stations™. SSI will select its particular Sky Station™ configuration as a result of a Request for Proposal (RFP) process with the qualified vendors subsequent to receipt of Commission authorization to construct, deploy and operate a GSTS system.

1. Mechanical Systems

The weight and buoyancy of each Sky Station™ is as follows:

Total buoyant gas volume	800,000 m^3
Total buoyancy	37 tons
Envelope and Duct Weight	11.7 tons
Fuel Cells	10.53 tons
Solar Cells	2.07 tons
Power Cables & Wiring	0.50 tons
Main Engines	1.00 tons
Propellers & Gears	2.00 tons
Communications Payload	2.80 tons
Control Equipment	0.60 tons
Empennage	4.40 tons
Reinforcement	1.40 tons
Total Weight	37.00 tons

2. Power Systems

Each Sky Station™ uses solar power, battery power and ion power. Each of these three sub-systems is discussed in more detail below.

a. Solar Power

The Sky Station™ structure includes a broad flat platform that is covered with high efficiency solar arrays. These arrays generate one megawatt of power, most of which is used to power the primary communications payload. Provision is made for a 50% degradation of solar panel output over time, resulting in 500 kilowatts of end of life power. Reserving 20 kilowatts of power for stationkeeping, battery charge and margin (i.e., Corona Ion Engines™), and using a DC-RF conversion efficiency of 33%, there will be 160 kilowatts of RF power available at end of life.

b. Battery Power

Fuel cells are used for battery power when the Sky Station™ is in darkness. There is no issue of cloud cover because the stratosphere is above all clouds. However, at night and during solar eclipses, the solar electric power must be supplemented. Correspondingly, nearly 30% of the weight of each Sky Station™ consists of fuel cells. The fuel cells generate approximately 150 kilowatts of power at night. After reserving 20 kilowatts for other needs, this is approximately 80% of the daytime power generated by the solar arrays and is compatible with the reduced communications load expected at night.

c. **Ion Power**

The Sky Station™ uses the plentiful flux of ions available in the stratosphere to generate the propulsion necessary to remain stationary. SSI's revolutionary Corona Ion Engine™ includes emitter electrode assemblies, each of which comprises a plurality of pointed electrodes.[4/] The solar charged electrodes are biased at a negative voltage of at least -3000 volts to eject, by means of field emission, energetic electrons, forming a plasma of electrons and positive ions.

The positive ions, that are heavier than the electrons by a factor of 30,000, are attracted to and hence accelerate toward the negative electrodes, imparting a momentum to the electrodes. This imparted momentum is equal to the ion mass times their acceleration velocity. The total amount of momentum that is imparted to the Corona Ion Engine™ structure is equal to the total flux of ions, that is equal to the ion density times velocity, times the momentum of each ion.

The atmospheric drag on the platform system in the stratosphere is sufficiently low because of the low atmospheric pressure. Since the platform will be above 99% of the atmosphere, the propulsion produced by the ion drive is sufficient to counter the drag force so as to move the platform to its deployment location and maintain the platform in a stationary position against the modest stratospheric wind.

[4/] SSI's Chief Scientist and Executive Vice President, Dr. Alfred Wong, invented the Corona Ion Engine™.

SSI has proven the feasibility of its Corona Ion Engine™ technology in atmospheric chamber testing and will be engaged in a series of further engineering validation exercises leading up to full-scale deployment in its Sky Station™ GSTS system.

3. Control Systems

Each Sky Station™ uses a control system based on multiply redundant GPS-receivers, interfaced via an on-board position-control system to the Corona Ion Engines™. This autonomous system enables the Sky Stations™ to remain fixed in position to within 100 feet in all three dimensions, and further enables the Sky Station™ antenna assembly to remain accurately oriented with a maximum deviation of 0.1 degrees in any direction. In addition, all GPS information and Corona Ion Engine™ activation data is continuously downlinked to Sky Station™ control centers via embedded telemetry links. The capability always remains for ground controllers to navigate and control each Sky Station™ via telemetry commands.

It should be noted that there are few position-disturbing forces in the stratosphere, which is above 99% of the oxygen atmosphere.

4. Communications Systems

The Sky Station™ communications systems consist of the stratospheric communications payload, ground switching systems and user communicators. All three of these systems exchange digital information in demand assigned 64 kbps (ISDN-B) channels.

a. <u>The Stratospheric Payload</u>

The Stratospheric Payload consists of a 47 GHz beam-forming phased array antenna and a very large bank of regenerative processors that handle receive, frequency demux, demodulation, decoding, data multiplexing, switching, encoding, modulating and transmitting functions. The stratospheric communications payload will be specified to reliably receive, regenerate, switch, and retransmit over one-half million transmissions simultaneously for a period of not less than ten years. Filters will segment the incoming communications stream based on phased array information and frequency.

Separate 32dBi transmit and receive antennas will be used, each about 8 inches in diameter. A millimeter waveguide feed array will project a large number of cellular coverage areas on the surface of the earth. The precise power allocated to each cellular coverage area, and its boundary, will be capable of being changed via ground control center commands.

The Stratospheric Payload requires 160 kilowatts of end-of-life power. This power may be allocated equally to each of 2,100 cells, or may be differentially allocated among cells based on channel demand, or based on the need to provide more transmit power to outlying cells. As an example, if each SSI GSTS communicator, called a Stratus™ Communicator, required 100 milliwatts of payload power, the communications payload has an overall capacity of approximately 1.6 million simultaneous Stratus™ Communicators. Of course not all of these Stratus™ Communicators can be accommodated in the same geographical area due to frequency constraints. If SSI is assigned initially 10 + 10 Mhz of user spectrum, there would be adequate bandwidth and power for 20 simultaneous users per cell. At 70 KHz per communicator (half duplex), this capacity calculation requires only 1.4 MHz per cell, and with hexagonal-pattern frequency reuse, only 10 MHz per Sky Station™ user link (half duplex). Under the assumptions of this paragraph, maximum power utilization of this bandwidth would occur with 76 watts per cell. In fact, SSI intends to use substantially less power per cell but retain the ability to power additional bandwidth per cell should the Commission assign more bandwidth to SSI after it receives its initial authorization, for example, if additional spectrum is available or becomes available due to subsequent failure of other licensees to meet their due diligence milestones.

SSI's business plan calls for 18 million Sky Station™ subscribers after five years of service. Assuming even distribution of these 18 million subscribers across 180 Sky Stations™[5/], there would be 100,000 subscribers per Sky Station™. Assuming further that these 100,000 subscribers were evenly distributed across 2,100 cells, there would be 47 subscribers per cell, and 100,000 subscribers in a 400,000 square mile coverage area. This is a reasonable fit with the 20 users per cell bandwidth limited loading capacity calculated above, especially since subscribers are likely to be on-line for only part of the time. In other words, the Sky Station™ capacity is sized appropriately for its associated business plan and market forecast, and yet has a built-in "surge capacity" for greater capacity should the market demand and bandwidth be available.

[5/] 180 Sky Stations™ are assumed here instead of the 250 stations applied for because the newest Sky Stations™ would be lightly loaded in the fifth year.

The Stratospheric Payload will need to incorporate a state-of-the-art baseband switching matrix. This technology has evolved rapidly in the past few years as a result of both NASA and ESA funded programs. Complex satellite baseband processors are now available from a number of vendors in both the United States and Europe.

The overall number of discrete electronic components required for the Stratospheric Payload is large compared with that normally implemented in satellite communications systems. However, even taken as a whole, SSI's requirement for thousands of electronic circuits per stratospheric platform, multiplied by 250 platforms, still totals only a fraction of the electronic switched circuit requirements of the PSTN, and much less than the cellular industry alone is projected to have by the year 2005.

SSI plans to procure its millimeter wave technology from qualified suppliers pursuant to an NRE-funded RFP. Companies that are qualified in the millimeter wave band include Raytheon, Matra, Hewlett Packard, Lockheed Martin, North American Rockwell, Alenia, and NEC, among several others. The actual size of the 32 dBi antennas on the Sky Stations™ will be quite small -- less than 8 inches in diameter -- a reflection of the millimeter wave bands that are being utilized.

With the marketplace-oriented regulatory structure SSI has proposed for GSTS, SSI does not believe it is necessary for the Commission to require information on the detailed engineering design of Sky Station™ communication payloads and cellular coverage patterns. Nevertheless, SSI will be pleased to provide this information to the Commission upon request, and SSI reserves the right to amend its Application to comply with whatever technical qualification rules the Commission decides to adopt.

Furthermore, link budgets for the user telecommunications paths are provided in Section 3 (C) (1) and (2) below and the coverage contours are described in Section 3 (C)(3) below.

b. Switching Centers

Within each Sky Station™ coverage area on the surface of the earth there will be several geographically-spaced digital switches that provide interface to the PSTN and the Internet. The switches will be designed to handle the maximum number of simultaneous calls. Calls will be routed to the most appropriate switch based on information determined at the Sky Station™ baseband processor in accordance with on-board programming. Each switch will also serve as an Internet gateway site.

The switching centers serve as base stations in the GSTS network. Accordingly, each switching center will be assigned a block of bandwidth appropriate to its needed call handling capability. This bandwidth will be reused in each polarization, and can be reused again at another switching center a short distance away due to the narrow beamwidth that prevails at 47 GHz. Furthermore, with appropriate coordination, different GSTS licensees can be assigned the same base station bandwidth again owing to the narrow beamwidths at 47 GHz. The amount of bandwidth needed for each switching center is approximately equal to the number of active cells divided by the number of switching centers times the bandwidth assigned to each cell times the frequency reuse factor. However, this amount of bandwidth may vary considerably over time and will be reduced over time as greater numbers of calls occur directly among Stratus™ Communicators in the same Sky Station™ coverage area rather than through the PSTN.

Applications to operate U.S. ground stations will be made at a later date. SSI intends to implement its international ground stations in conjunction with strategic partnership arrangements with telecommunications organizations in other countries.

c. <u>Stratus™ Communicators</u>

Stratus™ Communicators are small personal communications devices using solid state MMIC technology capable of greater than .5% frequency stability. These devices will digitize and format incoming information in accordance with the ITU-T H.263 audio-video compression algorithms, impress the same upon a 70 KHz carrier, and transmit this information out a small antenna. Each Stratus™ Communicator will have a unique ID code that enables it to extract communications intended for it from downlinked transmissions in the 47.9 to 48.2 GHz band.

The Stratus™ Communicators will be built with a modular ability to be augmented with other telecommunications links such as cellular, PCS or unique nationally-authorized frequencies for indirect GSTS access via relay transmitters. The Stratus™ Communicators will also be capable of direct interface to the PSTN. The recently announced Oracle Internet device is a typical format for a Stratus™ Communicator.

Upon triggering the "send" button on the Stratus™ Communicator, the Sky Station™ communications payload will assign an uplink channel to a Stratus™ Communicator. As the incoming message is received, its header will be scanned for the telephone number of the intended recipient. If the recipient is part of the Sky Station™ GSTS system, an attempt will be made to connect directly to that recipient without the use of a base station, via a simple header reformatting process and retransmission. Each Sky Station™ and each switching center will maintain a database listing, continuously updated, of the last location of each Sky Station™ subscriber based on their last telephone call or system inquiry. A software program will direct a logical search for the intended recipient based on last known locations, cost and quality of the relevant PSTN, adjacent cell geometry and adjacent Sky Station™ geometry. If the incoming message indicates a recipient who is not a Sky Station™ subscriber, the call will be automatically directed into an available base station channel for interconnection to the PSTN.

SSI believes the mass production of consumer equipment in this frequency range is well within the ability of the electronics industry. It currently estimates that the Stratus™ Communicator will be built around a hybrid analog/digital VLSI ASIC, with approximately 100,000 logic gates and .25 micron technology. In quantities of several million units per year, such technology will cost less than $100 per unit. While this may translate into a retail price of $400-$500, much of this cost could be subsumed within service fees and thus will not be paid upfront by consumers.

The Stratus™ Communicators may also include a cellular phone capability that will be accessed whenever the stratospheric platform is unable to complete a communication, due for example to building blockage or any other short-term disruption in service. If a Stratus™ Communicator cannot receive transmissions from the stratospheric platform, then its internal logic will automatically look for a free cellular phone channel. Billing arrangements with local telecommunications organizations will be organized to ensure that the customer is properly billed for separate stratospheric and cellular phone calls. Moreover, blocked transmissions are less likely with stratospheric platforms than with low earth orbit platforms because in major metropolitan areas the former are generally at much higher angles of elevation.

d. <u>Antennas</u>

Stratus™ Communicators will come with different optional antennas depending on their intended zone of usage. Stratus™ Communicators intended for portable city use, where angles of elevation are high, will have an inconspicuous embedded antenna. However, as an option for frequent indoor use, there will be a powered infrared remote antenna that can attach to a window and connect to the Stratus™ Communicator at infrared wavelengths. Stratus™ Communicators intended for automobile or truck use will come with either a simple 3dBi external antenna if for city use (much like a cellular telephone car antenna), or with an automatically steerable or electronically steerable phased array 23dBi antenna if for highway/rural use (much like a geostationary mobile satellite antenna)

Stratus™ Communicators intended for use in outlying areas a hundred miles from a metropolitan area will work with a small 23dBi one-inch antenna, about the size of a business card, the 15 degree half power beamwidth of which will make for easy pointing. By simply typing in the coordinates of the user's location, the optional extended coverage Stratus™ Communicator will automatically point the built-in one inch antenna based on information stored in its memory as to the location of the nearest Sky Station™. The built-in video screen in the Stratus™ Communicator can also use iconic figures to show the user which way to face for a connection to the best path Sky